VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

(VJTI)

MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)

Curriculum

(Scheme of Instruction & Evaluation and Course contents)

For

Two Year Postgraduate Programme Leading to

Master of Technology (M.Tech.) Degree

in Electronics Engineering

Implemented from the batch admitted in Academic Year 2014-15

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Master of Technology (M.Tech.)

In

208 Electronics Engineering

SEMESTER I

Scheme of Instruction				Scheme of Evaluation				
S. No	**Course code**	**Course Title**	**L-T-P (Hours / week)**	**Credits**	**TA**	**IST**	**ESE**	**ESE hours**
1.	EC5001S	Computational Methods	3-1-0=4	4	20	20	60	3
2.	EC5002S	Advanced Communication Theory	3-1-0=4	4	20	20	60	3
3.	EC5003T	VLSI System Design	3-0-0=3	3	20	20	60	3
	EC5003P	VLSI System Design LAB	0-0-2=2	1	100 % CIE			
4.	EC5004T	Digital System Design	3-0-0=3	3	20	20	60	3
	EC5004P	Digital System Design LAB	0-0-2=2	1	100 % CIE			
5.		Program Elective course 1	3-1-0=4	4	20	20	60	3
6.		Program Elective course 2	3-0-0=3	3	20	20	60	3
		Program Elective course 2 LAB	0-0-2=2	1	100 % CIE			
		Total	27	24				

SEMESTER II

Scheme of Instruction				Scheme of Evaluation				
S. No	**Course code**	**Course Title**	**L-T-P (Hours /week)**	**Credit s**	**TA**	**IST**	**ESE**	**ESE hours**
1.	EC5005S	Research Methodology	3-1-0=4	4	20	20	60	3
2.	EC5006S	Advanced DSP	3-1-0=4	4	20	20	60	3
3.	EC5007T	Nano Electronics	3-0-0=3	3	20	20	60	3
	EC5007P	Nano Electronics LAB	0-0-2=2	1	100 % CIE			-
4.	EC5008T	Embedded System Design	3-0-0=3	3	20	20	60	3
	EC5008P	Embedded System Design LAB	0-0-2=2	1	100 % CIE			-
5.		Program Elective course 3	3-0-0=3	3	20	20	60	3
6.		Program Elective course 4	3-0-0=3	3	20	20	60	3
		Program Elective course 4 LAB	0-0-2=2	1	100 % CIE			-
		Technical Seminar*	0-0-4=4	2	100 % CIE			
		Total		30	25			

Abbreviations: **L**: Lecture, **T**: Tutorial, **P**: Practical, **TA**: Teacher Assessment / Term work Assessment, **IST**: In Semester Tests (comprise of average of two In semester tests), **ESE**: End Semester Written Examination, **CIE**: Continuous In-semester Evaluation

List of Electives:

Course Code		ELECTIVES
Program Elective Course 1	EC5101S	Electronics in Medicine
	EC5102S	Artificial neural networks and machine learning
	EC5103S	E-Security
Program Elective Course 2/ Course2 LAB	EC5104T	Applications of DSP
	EC5104P	Applications of DSP LAB
	EC5105T	Modern communication networks
	EC5105P	Modern communication networks LAB
	EC5106T	RF Integrated Circuits
	EC5106P	RF Integrated Circuits LAB

Course Code		ELECTIVES
Program Elective Course 3	EC5111S	Speech Processing
	EC5112S	Nano logic Design
	EC5113S	Computer Architecture
Program Elective Course 4/ Course 4 LAB	EC5114T	Virtual Instrumentation
	EC5114P	Virtual Instrumentation LAB
	EC5115T	Advanced Mobile Communication
	EC5115P	Advanced Mobile Communication LAB
	EC5116T	Advanced Image and Video Processing
	EC5116P	Advanced Image and Video Processing LAB-

SEMESTER III and SEMESTER IV – Project work

S. No	Course Category	Course Title	Credits	Evaluation pattern	Semester
1.	Project	Stage –I Presentation	4	Graded evaluation by a committee of atleast two examiners including supervisor (guide)	III
2.	Project	Stage –II Presentation	4	Graded evaluation by a committee of atleast two examiners including supervisor (guide)	III
3	Project	Stage –III Presentation	4	Graded evaluation by a committee of atleast two examiners including guide (guide)	IV
4.	Project	Final Presentation and Viva Voce	12	Graded evaluation by a committee of atleast two examiners including supervisor (guide) and an external examiner	IV

PROGRAM EDUCATIONAL OBJECTIVES

- **To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to formulate, analyze & solve engineering problems related to Electronics Engineering.**
- **Students to succeed in employment, profession and/or to pursue research education in Electronics Engineering.**
- **Students to exhibit knowledge for innovate, create and design electronic engineering systems.**
- **To inculcate in students professional and ethical attitude, effective communication skills and teamwork to become a successful professional in global perspective.**

PROGRAM OUTCOMES (POs)

At the end of Post Graduate Program, students will have

- **Sufficient knowledge of mathematics, science and Electronics Engineering and ability to apply this knowledge for modelling and solving Electronics Engineering problems using techniques, skills and modern Electronics Engineering tools necessary for engineering practice.**
- **An ability to design, develop and test electronics systems in the areas related to analog and digital electronics, signal processing, embedded systems and VLSI design.**
- **Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.**
- **An understanding of professional and ethical responsibility and ability to communicate effectively.**
- **Be aware of current good practices of electrical & electronics engineering for sustainable development.**
- **Ability to communicate effectively as an individual and in group.**
- **Be aware that a professional engineer's work has social, culture, global and environmental ramification.**

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I**
Course Code	**EC5001S**
Course Title	**COMPUTATIONAL METHODS**

COURSE OBJECTIVES

The course is designed to provide M. Tech. Students across all engineering discipline a view of using various computational techniques and tools for analysis, decision making and solution of engineering problems. Following are the course objectives:

- Students will be able to develop mathematical models of lower level engineering problems.
- Students will learn how to solve nonlinear equations numerically.
- Students will be introduced to fundamental matrix algebra concepts and shown how to solve simultaneous linear equations numerically.
- Students will learn how to curve fit (interpolation and regression) discrete date.
- Students will learn how to numerically integrate continuous and discrete functions.
- Students will learn how to numerically solve ordinary differential equations that are initial value or boundary value problems.

COURSE OUTCOMES

In the course Computational Methods, the program objectives are met as follows

- Understand the concept and steps of problem solving - mathematical modeling, solution and implementation.
- Knowledge and understanding of, and the ability to use, mathematical techniques.
- Ability to understand and apply mathematical reasoning in several different areas of mathematics.

Overview

Overview of microcomputer systems. Hardware and software principles.

Module 1: Algebraic Equations

Formulation and solution of linear system of equations, Gauss elimination, LU, QR decomposition, iteration methods (Gauss-Seidal), convergence of iteration methods, Singular value decomposition and the sensitivity of rank to small perturbation

Module 2: Interpolation & Regression Methods

Newton's divided difference, interpolation polynomials, Lagrange interpolation polynomials, Linear and non-linear regression, multiple linear regression, general linear least squares.

Module 3: Transform Techniques

Vector spaces, Basis vectors, Orthogonal/Unitary transform, Fourier transform, Laplace transform.

Module 4: Optimization Techniques for Engineers

Local and global minima, Line searches, Steepest descent method, Conjugate gradient method, Quasi Newton method, Penalty function.

Module 5: Graph Theory

Graphs and Matrices, simple graph, cyclic graph, complete graph, properties of the Laplacian matrix and relationwith graph connectivity. Non-negative matrices. Applications of graph theory to engineering problems.

Recommended Reading

1. "Numerical Methods for Engineers', Steven C. Chapra and Raymond P. Canale, McGraw Hill
2. "Probability and Statistics in Engineering and Management Studies", Hines and Montrogmery, John Willey
3. "Numerical Methods for Engineers", Santosh Gupta, New age international publishers
4. "Graphs and Matrices", R. B. Bapat, TRIM Series, Hindustan Book Agency, 2011
5. "Algebraic Graph Theory ", C. Godsil and G. Royle, Springer, New York, 2001 (AvaiLABle in Indian edition)

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I
Course Code	**EC5002S**
Course Title	**ADVANCED COMMUNICATION THEORY**

COURSE OBJECTIVES

- Become familiar with the fundamentals of Advance digital communication systems.
- Understand transmission and detection of digital signals
- Understand how to analyze a digital communications system
- Become familiar with the fundamentals of channel coding.
- Understand and analyze synchronization systems.
- Understand the basics of information theory and error correcting codes.

COURSE OUTCOMES

- Students should be able to analyze digital communication signals as vectors.
- Students understand the principles of maximum a posteriori and maximum likelihood detection.
- Students understand the basics of PAM, QAM, PSK, FSK, and MSK.
- They can analyze probability of error performance of such systems and are able to design digital communication systems based on these modulation techniques as block diagrams.
- Students understand and are able to analyze equalizers.

Overview

Module 1: Source Coding

Average mutual information and entropy, Coding for discrete and analog sources, Source coding, Rate distortion theory, Quantization, Waveform coding.

Module 2: Advanced Digital and Demodulation Techniques

Continuous Phase PSK (CPPSK), QPSK, GMSK ,QAM , Trellis Coded Modulation (TCM) Clock and Carrier Recovery Schemes

Module 3: Signal design for band limited channels

Characterization of band limited channels Signal design for band limited channels

Module 4: Communication through band limited linear filters

Optimum receiver for channels with ISI & IWGN, Linear Equalization, Design Feedback Equalization, Adaptive Equalization

Module 5: Spread spectrum signal for Digital communication

Module 6: Digital communication through fading multipath channels

Recommended Reading

1. Digital communication : John G. Proakis, McGraw Hill (1989)
2. Communication Systems: Haykin S, John Wiley & sons (2001)
3. Digital communications: Bernard Sklar , Pearson Education(2003)
4. Communication Systems Engineering : John G.Proakis, Masoud Salehi Pearson Education(2007)

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I**
Course Code	**EC5003T**
Course Title	**VLSI SYSTEM DESIGN**

COURSE OBJECTIVES

- To introduce students to basic concepts of digital VLSI chip design using the simpler VLSI technology.
- To design and analyze digital circuits, incorporating into a VLSI chip.
- To design for low power and design for performance, work in small groups and bring together design components into a full custom chip.
- To build prior knowledge of digital circuits, digital logic, and computer architecture concepts to teach how complex chip-scale systems can be designed.

COURSE OUTCOMES

- An ability to design logic circuit layouts for both static CMOS and dynamic clocked CMOS circuits.
- An ability to extract the analog parasitic elements from the layout and analyze the circuit timing using a logic simulator and an analog simulator.
- An ability to insert elementary testing hardware into the VLSI chip.
- An ability to design elementary data paths for microprocessors, including moderate-speed adders, subtracters and multipliers.
- An ability to estimate and compute the power consumption of a VLSI chip.
- An ability to assemble an entire chip and add the appropriate pads to a layout.
- An ability to explain the chip technology scaling process.

Overview

Module 1: Digital Systems and VLSI

Integrated Circuit Manufacturing - Technology, Economics. CMOS Technology - Power Consumption, Design and Testability, Reliability. Integrated Circuit Design Techniques - Hierarchical Design, Design Abstraction, Computer-Aided Design. IP-Based Design - Why IP?, Types of IP, IP Across the Design Hierarchy, The IP Life Cycle, Creating IP, Using IP.

Module 2: Fabrication and Devices

Fabrication Processes. Transistors - Structure of the Transistor, A Simple Transistor Model, Transistor Parasitics, Tub Ties and Latchup, Advanced Transistor Characteristics, Leakage and Subthreshold Currents, Thermal Effects, Spice Models. Wires and Vias – Wire Parastics, Skin Effect in Copper Interconnect. Fabrication Theory and Practice – Fabrication Errors, Scaling Theory and Practice, SCMOS Design Rules, Typical Process Parameters, Lithography for Nanoparameter Processes. Reliability – Traditional Sources of Unreliability, Reliability in Nanometer Technologies. Layout Design and Tools – Layouts for Circuits, Stick Diagrams, Hierarchical Stick Diagrams, Layout Design and Analysis Tools, Automatic Layout.

Module 3: Logic Gates

Combinational Logic Functions. Static Complementary Gates – Gate Structures, Basic Logic Gates, Logic Levels, Delay and Transition Time, Power Consumption, Speed-Power Product, Layout and Parasitics, Driving Large Loads. Switch Logic. Alternative Gate Circuits – Pseudo-nMOS Logic, DCVS Logic, Domino Logic. Low-Power Gates. Delay through Resistive Interconnect – Delay through an RC Transmission Line, Delay through RC Trees, Buffer Insertion in RC Transmission Line, Crosstalk between RC wires. Delay through Inductive Interconnect – RLC Basics, RLC Transmission Line Delay, Buffer Insertion in RLC Transmission Line. Design-for-Yield. Gates as IP.

Module 4: Combinational Logic Networks

Standard Cell-Based Layout – Single-Row Layout Design, Standard Cell Layout Design. Combinational Network Delay – Fanout, Path Delay, Transistor Sizing, Logic Synthesis. Logic and Interconnect Design – Delay modeling, Wire Sizing, Buffer Insertion, Cross talk Minimization. Power Optimization – Power Analysis. Switch Logic Networks. Combinational Logic Testing – Gate Testing, Combinational Network Testing, Testing and Yield.

Module 5: Sequential Logic Networks

Latches and Flip-Flops – Timing Diagrams, Categories of Memory Elements, Latches, Flip-Flops. Sequential Systems and Clocking Disciplines – Clocking Disciplines, One-Phase Systems for Flip-Flops, Two-Phase Systems for Latches. Performance Analysis – Performance of Flip-Flop-Based Systems, Performance of Latch-Based Systems, Clock Skew, Retiming, Transient Errors and Reliability. Clock Generation. Sequential System Design – Structural Specification of Sequential Machines, State Transition Graphs and Tables, State Assignment. Power Optimization. Design Validation. Sequential Testing.

Module 6: Subsystem Design

Combinational Shifters, Adders, ALUs, Multipliers. High-Density Memory – ROM, Static RAM, The Three-Transistor Dynamic RAM, The One-Transistor Dynamic RAM, Flash Memory. Image Sensors, Field-Programmable Gate Arrays, Programmable Logic Arrays. Buses and Networks-on-Chips – Bus Circuits, Buses as Protocols, Protocols and Specifications, Logic Design for Buses, Microprocessor and System Buses, Network-on-chips. Data Paths, Subsystems as IP.

Module 7:Floorplanning

Floorplanning Methods – Chip-Level Physical Design, Block Placement and Channel Definition, Global Routing, Switchbox Routing. Global Interconnect – Interconnect Properties and Wiring Plans, Power Distribution, Clock Distribution. Floorplan Design – Floorplanning Tips, Design Validation. Off-Chip Connections – Packages, The I/O Architecture, Pad Design.

Recommended Reading

1. Wayne Wolf, Modern VLSI Design, PHI, 2009.
2. N. Weste and K. Eshranghian, Principles of CMOS VLSI Design, Addison Wesley, 1985.
3. Eshraghian, Pucknell, Eshraghian, "Essentials of VLSI circuits and systems", PHI, 2005.
4. Sung-Mo Kang, Yusuf Leblebici, Cmos Digital Integrated Circuits, Tata McGraw Hill
5. C.Y. Chang and S.M.Sze (Ed), ULSI Technology, McGraw Hill Companies Inc, 1996.
6. S.M. Sze (Ed), VLSI Technology, 2nd Edition, McGraw Hill, 1988.

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I
Course Code	EC5003P
Course Title	VLSI SYSTEM DESIGN LAB

COURSE OBJECTIVES

- To study different simulation tools used for VLSI implementation like Microwind/DSCH, Image, Xilinx and other CAD Tools.
- Design and simulation of semiconductor devices, integrated circuits and Process fabrication.
- Design of standard cells and gate array based circuits and their simulation.

COURSE OUTCOMES

- To get experience on computer aided testing of integrated circuits.
- To design static and dynamic circuits & Layout of Integrated circuits.
- Understanding of digital design and timing analysis.

Overview

1. Semiconductor material characterization
2. Design and simulation of semiconductor device.
3. Design and simulation of integrated circuits
4. Process Simulation for integrated circuits fabrication
5. Design of standard cells and gate array based circuits and their simulation
6. Computer aided testing of integrated circuits
7. Design of static and dynamic circuits
8. Layout of Integrated circuits
9. Digital design and timing analysis
10. Project on design, analysis and layout of Integrated circuits

Recommended Reading

1. Wayne Wolf, Modern VLSI Design, PHI, 2009.
2. N. Weste and K. Eshranghian, Principles of CMOS VLSI Design, Addison Wesley, 1985.
3. Eshraghian, Pucknell, Eshraghian, “Essentials of VLSI circuits and systems”, PHI, 2005.

4. Sung-Mo Kang, Yusuf Leblebici, Cmos Digital Integrated Circuits, Tata McGraw Hill
5. C.Y. Chang and S.M.Sze (Ed), ULSI Technology, McGraw Hill Companies Inc, 1996.
6. S.M. Sze (Ed), VLSI Technology, 2nd Edition, McGraw Hill, 1988.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I**
Course Code	**EC5004T**
Course Title	**DIGITAL SYSTEM DESIGN**

COURSE OBJECTIVES

- To get prepared for nano IC design, quantum computing and embedded system.
- To describe, design, simulate, and synthesize computer hardware using the Verilog hardware description language.
- To rapidly design combinational and sequential logic.
- To rapidly design complex state machines.
- To implement state machines using Field-Programmable Gate Arrays.
- To design high-speed computer arithmetic circuits.
- To design a computer to be fault-tolerant.
- To design a computer so that it can test itself with built-in circuitry.

COURSE OUTCOMES

- Students apply high level design languages and knowledge of boolean algebra to define and development digital modules.
- Students must comprehend digital module specifications, and develop digital designs to meet these specifications
- Students follow design specifications to implement systems that solve minor mathematical and logical operations on digital data.
- Students should design and program logic modules and display devices to measure circuit operating speed.

Overview

Review of combinational and sequential logic design

Module 1: Programmable logic devices

Architecture of PLDs like SPLD,CPLD and FPGA, Types of FPGAs, Fine, media and coarse grain architecture, logic blocks, embedded RAMS, MAC, embedded processor cores, clocks, IOs, high speed transceivers, Rapid IOs, IP, FPGA programming techniques, FPGA versus ASIC, Various types of design flow, Selection trade off, Xilinx and Altera FPGA, routing and placement, FPGA connections, parallel loads, FPGA based combinational and sequential design.

Module 2: Digital modeling and synthesis

Abstraction, hardware modeling, graphs, interconnection networks, cubic notation, groups, finite rings, finite fields, homomorphism, matrices, vector spaces, graphs, graph coloring, NP complete and NP hard problems, Reed – Muller expression, Kronecker expression, Applications of AR, Walsh expression, decision diagrams, two level logic synthesis, multilevel logic synthesis, donot care terms, FPGA synthesis, flow graphs, System C modeling.

Module 3: Multivalued logic

Introduction, algebras, data structures, spectral techniques, multivalued trees and decision diagrams, change in multivalued circuits, Reed – Muller expression, linear word level expression, MVL functions and operators, MVL algebra.

Module 4: Asynchronous sequential machine analysis and design

Introduction, fundamental mode of operation, stability criterion, LPD and set – reset model, state diagram, mapping algorithm, design using LPD, C-element, Muller and Huffman models, sanity circuit, Asynchronous FSM design using HDL

Module 5: Timing and clocking

Delay models, static timing analysis of combinational circuit, pipelining the design, clocking and skewing, Clocking synchronous FSM, wave pipelining, retiming, jitters, energy parameters, clock balancing, global reset, clock conditioning circuits, PLL application.

Module 6: Digital signal integrity and testing

Types of testing, Logic simulation, types of simulation, hazards, other logic values, fault modeling, ATG, stuck at fault, Races, noise in digital system, transmission line effects, termination techniques, cross talk, minimization cross talk, EMI radiation

Module 7: Research topics in digital design automation

Published research papers on computer aided integrated circuit design IEEE transaction

Recommended Reading

1. “FPGAs: World class design “by Clive Max field Newnes publication.
2. “Logic synthesis and verification algorithm” Gary Hachtel, Kluwer academic publication
3. “Multiple valued logic- concepts and representation” De Michael Miller, Morgan and clay pool publication
4. “Asynchronous sequential machine design and analysis” Tinder, Morgan and clay pool publication
5. “Digital system engineering” William J. Dally, Cambridge University press
6. “High speed digital system design” Stephen Hall, John Wiley and sons
7. “High speed digital design” Howard Johnson and Martin Graham, Pearson

8. “Digital system testing and testable design” MironAbramovici, Jaico publication
9. “Synthesis and optimization of digital circuits” Giovanni De Micheli, McGraw Hill.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I**
Course Code	**EC5004T**
Course Title	**DIGITAL SYSTEM DESIGN LAB**

COURSE OBJECTIVES

- To study different simulation tools used for VLSI implementation like Microwind/DSCH, Image, Xilinx and other CAD Tools.
- Design and simulation of semiconductor devices, integrated circuits and Process fabrication.
- Design of standard cells and gate array based circuits and their simulation.

COURSE OUTCOMES

- To get experience on computer aided testing of integrated circuits.
- To design static and dynamic circuits & Layout of Integrated circuits.
- Understanding of digital design and timing analysis.

Overview

1. Semiconductor material characterization
2. Design and simulation of semiconductor devices
3. Design and simulation of integrated circuits
4. Process Simulation for integrated circuits fabrication
5. Design of standard cells and gate array based circuits and their simulation
6. Computer aided testing of integrated circuits
7. Design of static and dynamic circuits
8. Layout of Integrated circuits
9. Digital design and timing analysis
10. Project on design, analysis and layout of Integrated circuits

Recommended Reading

1. "FPGAs: World class design "by Clive Max field Newnes publication.
2. "Logic synthesis and verification algorithm" Gary Hachtel, Kluwer academic publication
3. "Multiple valued logic- concepts and representation" De Michael Miller, Morgan and clay pool publication
4. "Asynchronous sequential machine design and analysis" Tinder, Morgan and clay pool publication

5. “Digital system engineering” William J. Dally, Cambridge University press
6. “High speed digital system design” Stephen Hall, John Wiley and sons
7. “High speed digital design” Howard Johnson and Martin Graham, Pearson
8. “Digital system testing and testable design” MironAbramovici, Jaico publication
9. “Synthesis and optimization of digital circuits” Giovanni De Micheli, McGraw Hill.

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I
Course Code	EC5101S
Course Title	Electronics in Medicine

COURSE OBJECTIVES

- To understand basic physiology of the body systems and associated electrical activity.
- Understand the basics of how the signals are obtained from the body that is to be measured by various machines.
- To relate Engineering and Instrumentation principles to the task of obtaining and analyzing physiological data.
- To have knowledge about the various devices used in medical field.
- To work professionally in one or more of the following areas:, medical Instrumentation, medical imaging, biomedical signal processing, rehabilitation Engineering and neuro engineering.
- To have an awareness of the safety aspects of medical instruments.

COURSE OUTCOMES

- Students should be able to understand physical foundations of biomedical engineering and how these are applied to the design of biomedical instruments, the analysis of biological systems, and the technological advancement for health care.
- To design a variety of electronic and/or computer-based devices for applications including biomedical instrumentation, medical imaging, physiological measurement, biomedical signal processing and medical informatics.
- Students should be able to define the quantities used clinically to describe ECG, Heart Rate, Respiration Rate, Blood Pressure, EEG, EOG and EMG.
- Students should get brief idea about various processes like Prosthesis, Diathermy ,Bio Telemetry and Telemedicine.

Overview

Module 1: Fundamentals of Medical Instrumentation

Anatomy and Physiology, Physiological Systems of the Body, Problems in measuring the Physiological variables, Components of Medical Instrument.

Module 2: Bioelectric Signals and Electrodes, Transducers

Origin of Bioelectric signals, Resting and Action Potentials, Depolarization and Repolarization, Propagation of Action Potentials. Electrode Theory, Recording Electrodes, Silver-Silver Chloride Electrodes, Microelectrodes. Transducer Principle, Classification of Transducers, various Transducers for the measurement of Physiological Events, Amplifiers and Signal Processing.

Module 3: The Cardiovascular System and Measurements

The Heart and Cardiovascular System: Heart Sounds and their measurements with Phonocardiograph, Stethoscope etc., Phonocardiogram. Blood Flow: Characteristics of Blood Flow, Measurement of Blood flow and Cardiac output with Magnetic Blood Flow meter, Ultrasonic Blood Flow Meter & Radio Graphic Method. Blood Pressure: Measurement of Blood Pressure with Indirect and Direct methods, Sphygmomanometry, Programmed Electrosphygmomanometry, Digital Blood Pressure meter, Impedance Plethysmography.

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Module 4:Generation & Recording of Bio Electrical Activities

Electrocardiogram: ECG Electrode Placement- “Bipolar Limb Lead Configuration by Einthoven, Unipolar Limb Leads(Wilson leads),Augmented Unipolar Limb Leads, Precordial and Marriott Leads”, ECG Recorders.

Electromyogram: EMG System, Electrodes used and their placement, Latency, Applications.

ElectroEncephalogram: EEG Electrodes and their placement-‘Anterior-Posterior’ and ‘Lateral’ measurements, Recording Modes of EEG, Applications of EEG.

ElectroRetinogram: Human Eye System, ERG Recording techniques, Standards of ERG, Applications of ERG.

ElectroOculogram: EOG basics, Recording methods, patient preparation, Arden Index, Diagnostic Utility of EOG,

Module 5: Measurements in the Respiratory System

Introduction, Physiology of the Respiratory System, Lung Volumes/Capacities, Instrumentation for measuring the Mechanics of Breathing- Kymograph, Spiro meter etc.

Module 6: Prosthesis

Introduction, Types of Prosthetic Devices, Application and working principle of various prosthetic devices eg.Myoelectric Control System for paralyzed arm, Audiometry and Hearing Aids.

Dialysis: Introduction, Function of the Kidneys, Artificial Kidney, Dialyzers, Membranes for Dialysis, Haemodialysis, Peritoneal Dialysis.

Module 7: Therapeutic Equipment

Introduction, High Frequency Heat Therapy, Short-wave Diathermy, Microwave Diathermy, Ultrasonic Therapy Unit., Endoscopy, Gastroscope,Bronchoscope, Sigmoidoscope, Laproscope. Pacemakers, Defibrillators.

Module 8: Medical Imaging Systems

Introduction, X-ray Machines and Digital Radiography, Computed Tomography, CT Scanners, Ultrasonic Imaging Systems, MRI & PET Scan, Thermal Imaging Systems,

Module 9: Bio Telemetry and Telemedicine

Introduction to Biotelemetry, The Components of a Biotelemetry System, Implantable Units, Single-Channel/Multi-Channel/Multi-Patient Telemetry Systems, Application of Telemetry in Patient Care, Telemedicine.

Module 10: Patient Care and Monitoring

The elements of Intensive-Care Monitoring, Patient-Monitoring Equipment – Different types, The Organization of Hospital for Patient-Care Monitoring.

Module 11: Patient Safety

Physiological effects of Electric Current, Shock Hazards and Leakage Currents, precautions to minimize Electric Shock Hazards and Leakage Current, Methods of Accident Prevention, Safety codes for electro medical equipment

Module 12: Application of Virtual Instrumentation in medical field

Introduction to Virtual Instrumentation and its applications in Medical field.

Recommended Reading

1. "Handbook of Biomedical Instrumentation" by R.S.Khandpur, Second Edition(21st Reprint 2013), Tata McGraw Hill Education Private Limited
2. "Biomedical Instrumentation and Measurements" by Leslie Cromwell, Fred J. Weibell& Erich A. Pfeiffer, Second Edition(2011), Prentice Hall of India publication
3. "Introduction to Biomedical Equipment Technology" by Joseph J. Carr and John M. Brown, Fourth Edition(2011), Pearson Education
4. "Biophysical measurements" by Strong P., Measurement Concepts publication
5. "Principles of applied biomedical instrumentation" by Leslie Alexander Geddes, L. E. Baker, Third Edition, Wiley publication
6. "Medical Instrumentation Application and Design" by John G. Webster, Third Edition(2011), Wiley publication
7. "Medical Electronics" by G. E. Donovan ,published by Butterworth & Co.
8. "Biomedical Instruments : Theory and Design" by Walter Welkowitz, Sid Deutsch &MetinAkay, Second Edition, Academic Press

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I
Course Code	EC5102S
Course Title	ARTIFICIAL NEURAL NETWORKS AND MACHINE LEARNING

COURSE OBJECTIVE

The course is designed to introduce the field of neural network systems and Artificial Neural Networks. An understanding of the basic concepts of machine learning is also the main goal of this subject.

COURSE OUTCOME

Students will be able to understand the fundamental concepts of the neural network systems. This is a new field of research thus students will get to know about the recent trends in research fields.

Overview

Module 1: Introduction: Biological neurons and memory

Structure and function of a single neuron; Artificial Neural Networks (ANN); Typical applications of ANNs : Classification, Clustering, Vector Quantization, Pattern Recognition, Function Approximation, Forecasting, Control, Optimization.

Module 2: Supervised Learning

Single-layer networks; Perceptron-Linear separability, Training algorithm, Limitations; Multi-layer networks-Architecture, Back Propagation Algorithm (BTA) Adaptive Multi-layer networks-Architecture, training algorithms; Recurrent Networks; Feed-forward networks; Radial-Basis-Function (RBF) networks;

Module 3: Unsupervised Learning

Winner-takes-all networks; Hamming networks; Maxnet; Simple competitive learning; Vector-Quantization; Counter propagation networks; Adaptive Resonance Theory; Kohonen's Self-organizing Maps; Principal Component Analysis;

Module 4: Associated Models and Optimization Methods

Hopfield Networks, Brain-in-a-Box network; Boltzmann machine; Hopfield Networks for-TSP, Solution of simultaneous linear equations; Iterated Gradient Descent; Simulated Annealing; Genetic Algorithm.

Module 5: Introductory Material to Machine Learning and AI

Motivations for Studying ML, Supervised and Unsupervised learning, Machine Learning in the Large

Module 6: Classical and Theoretical ML Topics

Concept Learning (also called Learning from Examples), Learning from Analogy, Explanation Based Learning, Structure Learning, Reinforcement Learning, Decision Tree Learning, Decision List Learning , Oracle Based Learning, Probably Approximately Correct (PAC) Model, Boosting, Bayesian Learning: Maximum Likelihood Estimates, Parameter Estimation, Bayesian Belief Networks

Module 7: Introductory Graphical Models Based Learning

Expectation Maximization as a fundamental technique, Hidden Markov Models (HMM): Motivation for Generative Models, Forward-backward Algorithm, Baum Welch Iteration, Feature Enhanced HMM.

Module 8: Maximum Entropy Markov Models (MEMM)

Motivation for Discriminative Models, Training of MEMMs (v) Introductory Optimization Based Methods: Neural Nets, Support Vector Machines, Genetic Algorithms (v) Applications: Text Learning, Speech Processing, Data Mining, Bioinformatics.

Recommended Reading

1. Simon Haykin, “Neural Networks - A Comprehensive Foundation”, Macmillan Publishing Co., New York, 1994.
2. A Cichocki and R. Unbehauen, “Neural Networks for Optimization and Signal Processing”, John Wiley and Sons, 1993
3. J. M. Zurada, “Introduction to Artificial Neural Networks”, (Indian edition) Jaico Publishers, Mumbai, 1997.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I**
Course Code	**EC5103S**
Course Title	**E-SECURITY**

COURSE OBJECTIVE

- This course is designed to introduce the concept of E-security, which is of immense importance in the field of networking.
- The basics of network security, concept of firewalls and web security will be introduced.
- The algorithms and the management techniques will also be studied.

COURSE OUTCOME

- The students will be well acquainted with the concept of E-security.
- They will be able to understand different aspects of management and security of the networking.
- This can encourage the students to further study this field from research point of view.

Overview

Module 1: INTRODUCTION ON SECURITY

Security Goals, Types of Attacks: Passive attack, active attack, attacks on confidentiality, attacks on Integrity and avaiLABility, Security services and mechanisms, Techniques: Cryptography, Substitution Ciphers, Transposition Ciphers, Stream and Block Ciphers-Steganography- Revision on Mathematics for Cryptography.

Module 2. SYMMETRIC & ASYMMETRIC KEY ALGORITHMS

Data Encryption Standards (DES), Advanced Encryption Standard (AES), RC4, principle of asymmetric key algorithms, RSA Cryptosystem.

Module 3: INTEGRITY, AUTHENTICATION AND KEY MANAGEMENT

Message Integrity, Hash functions: SHA 512, Whirlpool, Digital signatures: Digital signature Standards, Authentication: Entity Authentication: Biometrics, Key management Techniques.

Module 4. NETWORK SECURITY, FIREWALLS AND WEB SECURITY

Introduction on Firewalls, Types of Firewalls, Firewall Configuration and Limitation of Firewall, IP Security Overview, IP security Architecture, Authentication Header, Security payload, Securityassociations, Key Management, E-mail security: PGP, MIME,S/MIME, Web security requirement, secure sockets layer, transport layer security, secure electronic transaction, dual signature.

Module 5. WIRELESS NETWORK SECURITY

Security Attack issues specific to Wireless systems: Worm hole, Tunnelling, DoS, WEP for Wi Finetwork, Security for Broadband networks: Secure Ad hoc Network, Secure Sensor Networks

Recommended Reading

1. Behrouz A. Forouzan," Cryptography and Network security" Tata McGraw- Hill, 2008.
2. William Stallings,"Cryptography and Network security: Principles and Practice", 2nd Edition, Prentice Hall of India, New Delhi, 2002.
3. Atul Kahate," Cryptography and Network security", 2nd Edition, Tata McGraw-Hill, 2008.
4. R.K.Nichols and P.C. Lekkas, "Wireless Security".
5. H. Yang et al., "Security in Mobile Ad Hoc Networks: Challenges and Solution", IEEE Wireless Communications, Feb. 2004.
6. "Securing Ad Hoc Networks", IEEE Network Magazine, vol. 13, no. 6, pp.24-30, December 1999.
7. "Security of Wireless Ad Hoc Networks", http://www.cs.umd.edu/~aram/wireless/survey.pdf
8. David Boel et.al (Jan 2008), "Securing Wireless Sensor Networks – Security Architecture Journal of networks", Vol. 3. No. 1. pp. 65 -76.
9. Perrig, A., Stankovic, J., Wagner, D. (2004), "Security in Wireless Sensor Networks", Communications of the ACM, 47(6), 53-57.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I**
Course Code	**EC5104T**
Course Title	**Applications of DSP**

COURSE OBJECTIVE

- To create a thorough understanding of time and frequency domain concepts and the associated mathematical tools which are fundamental to all DSP techniques
- To provide a thorough understanding about the practical design, implementation, analysis and comparison of digital filters for processing of discrete time signals.

COURSE OUTCOME

- Students should be masters in analyzing discrete-time signals in the time domain and frequency domain, using different transforms.
- Students should be able to design various types of Digital Filters like FIR and IIR and implement it on processors.
- Students should be able take up advanced courses and do projects in signal processing and its applications.

Overview

Module 1: Discrete Time Signals

Discrete Time Signals, Sequences; representation of signals on orthogonal basis; Classifications; A/D and D/A conversion: sampling and quantization, antialiasing and smoothening filters, reconstruction of signals, relationship between spectra of discrete- and continuous- time representations.

Module 2: Discrete time systems:

Discrete system attributes, Analysis of LTI systems, Z-Transform, Frequency Analysis, Inverse Systems, Discrete Fourier Transform (DFT), Fast Fourier Transform algorithm, Hilbert Transform, Implementation of Discrete Time Systems.

Module 3: FIR Digital filters:

Concept of linear phase, types, position of zeros, Design using Window method, Frequency Sampling Techniques, Park-McClellan's method etc.;

Module 4: Design of IIR Digital Filters

Design analog filters like Butterworth, Chebyshev and Elliptic Approximations; Various techniques of conversion of analog filter into digital filters like Impulse Invariant, Derivatives, Bilinear transformation, Match Z-transform and its modifications., mapping of s-plane to z-plane, limitations, Effect of finite precision numerical effect.

Module 5. DSP Processor Fundamentals

DSP processor architecture, Software developments, Selections of DSP processors, Implementation considerations, finite word length effects, real time implementation, Hardware interfacing, DSP processor architectures: TMS 320C54XX, TMS 320C67XX, Blackfin processor: Architecture overview, memory management, I/O management, On chip resources, programming considerations, Real time implementations, Applications of DSP systems Design using fixed point and floating point implementations: FIR filters

Module 6: Application of DSP to Speech and Radar signal processing

Recommended Reading

1. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall.
2. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall.
3. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall
4. J.R. Johnson, Introduction to Digital Signal Processing, Prentice
5. Hall D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing, J Wiley and Sons, Singapore
6. Salivahanan S, Vallavaraj A, Gnanapriya, Digital Signal Processing, Mc Graw Hill, 2nd edition

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I
Course Code	**EC5104P**
Course Title	**Applications of DSP LAB**

COURSE OBJECTIVE

- This course will provide a brief knowledge about MATLAB and its applications in the area of signal processing.
- To emphasize on fundamentals of Digital Signal Processing and verify theoretical aspects with the help of higher level computational languages such as MATLAB.

COURSE OUTCOME

- Students should be able to apply the different transforms for the characterizations of signals and systems.
- Students should be able to design digital filters for various applications. .

Overview

1. Characterization of LTI systems
2. Frequency response of the given Transfer function.
3. Fourier transform and Fourier series of time domain digital signal.
4. DTFT of discrete time signals.
5. Fast Fourier Transforms (FFT).
6. Design of different FIR filters.
7. Design of different IIR filters.
8. Effect of finite register length in FIR filter design.
9. Implementation of one algorithm on a DSP Processor.

Recommended Reading

1. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall.
2. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall.
3. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall
4. J.R. Johnson, Introduction to Digital Signal Processing, Prentice
5. Hall D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing, J Wiley and Sons, Singapore
6. Salivahanan S, Vallavaraj A, Gnanapriya, Digital Signal Processing, Mc Graw Hill, 2nd edition

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I**
Course Code	**EC5105T**
Course Title	**MODERN COMMUNICATION NETWORKS**

COURSE OBJECTIVE

- Develop an understanding of computer communication principles.
- To develop an understanding of the underlying structure of networks and how they operate.
- To describe layered communication, the process of encapsulation, and message routing in network equipped devices using appropriate protocols.
- To study Ethernet (IEEE 802.3), token ring (IEEE802.5), fiber distributed data interface (FDDI), distributed - queue dual-bus (DQDB), Frame Relay and switched multimegabit data service (SMDS).
- To study DLL and MAC layer protocols TCP & UDP protocols, IPV4, IPV6 and FTP.
- To study ATM network, features, addressing, signalling, routing, ATM header structure, management and control, BISDN.
- To Optical networks, WDM systems, cross connects, optical LAN, Optical paths and Networks.

COURSE OUTCOME

- To independently understand basic computer network technology.
- To understand and explain Data Communications System and its components.
- To identify the different types of network topologies and protocols.
- To enumerate the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
- To identify the different types of network devices and their functions within a network
- To understand and build the skills of subnetting and routing mechanisms.
- To familiarize with the basic protocols of computer networks and how they can be used to assist in network design and implementation.

Overview

Module 1: Review of Networking Concepts

Packet switched Networks : OSI and IP models, ARQ retransmission strategies. Selective repeat ARQ. Framing and standard Data Link Control protocol-HDLC, SDLC, LAPD. Queuing models in communication networks.

Ethernet (IEEE 802.3), token ring (IEEE802.5), fiber distributed data interface (FDDI), distributed - queue dual-bus (DQDB), Frame Relay and switched multimegabit data service (SMDS).

Internetworking issues: Bridges, Routers and Switched networks. Routing and Flow Control algorithms in data networks.

Module 2: Internet and TCP/IP networks

Internet protocol,IPV4,Algorithms, Multicast IP,Mobile IP,IPV6, TCP and UDP ,FTP, performance of TCP/IP Networks.

Module 3: ATM Network

ATM network, features, addressing, signalling, routing, ATM header structure, ATM adaptation layer (AAL), management and control, BISDN,Inter-networking with ATM. Optical networks, WDM systems, cross connects, opticalLAN, Optical paths and Networks.

Module 4: WIRELESS LANS, PANS AND MANS

Introduction, fundamentals of WLAN –technical issues, network architecture, IEEE 802.11-physical layer, Mac layer mechanism, CSMA/CA, Bluetooth- specification, transport layer, middleware protocol group, Bluetooth profiles, WLL –generic WLL architecture, technologies, broadband wireless access, IEEE 802.16 –differences between IEEE 802.11 and 802.16,physical layer, data link layer.

Recommended Reading

1. Leon Gracia, Widjaja, “Communication Networks”, Tata McGraw Hill,
2. Behrouz.a. Forouzan, “Data Communication and Networking”, Tata McGraw Hill
3. Jean Walrand&PravinVaraiya, “High Performance Communication Networks” ,\ Elsevier
4. Wllliam Stallings, “Wireless Communication and Networks”, Prentice Hall, 2nd edition, 2005.
5. Prentice
6. Larry L. Peterson, Bruce S. Davie, “Computer networks”, 4th Edition, Elsevier

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I**
Course Code	**EC5105P**
Course Title	**MODERN COMMUNICATION NETWORKS LAB**

COURSE OBJECTIVE

- To perform experiments on framing sequence like bit stuffing and character stuffing.
- To implement error detecting code.
- To test different transmission flow control protocols.
- To test various routing information protocol (RIP).

COURSE OUTCOME

- To get familiarized with various routing protocols like Sliding Window Protocol, CSMA/CD, Ethernet, Token Ring Network, IP, TCP, Leaky Bucket Algorithm, ATM.
- Verification of Stop and Wait protocol, Go Back N protocol, Selective Repeat Protocol.

Overview

I. Framing Sequence

Bit Stuffing and character stuffing

II. Error Detecting Code

Cyclic Redundancy Check

III.Transmission Flow Control Protocols

Verification of Stop and Wait protocol

Verification of Go Back N protocol

Verification of Selective Repeat Protocol

IV. Routing Information protocol (RIP)

- Verification of distance vector routing algorithm
- Sliding Window Protocol and Go-back-N ARQ.
- CSMA/CD Media Access Control, Ethernet (IEEE 802.3).
- Token Ring Network.
- Transparent Bridge.

- Internet Protocol (IP).
- Transport Control Protocol (TCP).
- Leaky Bucket Algorithm (Traffic Management).
- ATM PNNI Routing.

Recommended Reading

1. Leon Gracia, Widjaja, "Communication Networks", Tata McGraw Hill,
2. Behrouz.a. Forouzan, "Data Communication and Networking", Tata McGraw Hill
3. Jean Walrand&PravinVaraiya, "High Performance Communication Networks" ,\ Elsevier
4. Wllliam Stallings, "Wireless Communication and Networks", Prentice Hall, 2nd edition, 2005.Prentice
5. Larry L. Peterson, Bruce S. Davie, "Computer networks", 4th Edition, Elsevier

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I
Course Code	EC5106T
Course Title	RF INTEGRATED CIRCUITS

COURSE OBJECTIVE

- Understand Modern RFIC Architectures, parameters and terminology and study the effects of parasitic on circuit performance at RF.
- Use of graphical design techniques for RFIC design and understanding the key issues of RFIC design.
- Applications include wireless communications, active and passive remote sensing, location sensing, radar, and radio astronomy.
- This course is focused on the key concepts in having RF capability on a chip.
- To study parasitic effects and current device modeling.
- To design of high-frequency, analog integrated circuits including low noise amplifiers, voltage-controlled oscillators, phase-locked loops, mixers and power amplifiers.

COURSE OUTCOME

- Understanding of the design and analysis of radio frequency integrated circuits and systems (RFICs) for communications is the major outcome of this course.
- Understanding the enabling integrated circuit technology and devices - Understanding the differences between standard CMOS devices and high-speed, high frequency and high power devices.
- Understanding the basics of RF circuits and systems; such as nonlinearity, sensitivity, dynamic range, matching and impedance transformation networks.
- Understanding RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers.
- Understanding of how to design Receiver and Transmitter architectures. Direct conversion and two-step transmitters.

Overview

Module 1: Introduction

RF design and Wireless Technology: Design and Applications, Complexity and Choice of Technology. Basic concepts in RF design, nonlinearity and Time Variance, Intersymbol Interference, random processes and noise. Sensitivity and dynamic range, conversion of gains and distortion.

Module 2: RF Modulation

Analog and digital modulation of RF circuits, Comparison of various techniques for power efficiency, Coherent and non-coherent detection, Mobile RF communication and basics of Multiple Access techniques. Receiver and Transmitter architectures. Direct conversion and two-step transmitters.

Module 3: RF Testing

RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers.

Module 4: BJT and MOSFET Behavior at RF Frequencies

Overview of RF Filter design and design issues in integrated RF filters, Active RF components & modeling, Matching and Biasing Networks. Basic blocks in RF systems and their VLSI implementation. Low noise Amplifier design in various technologies, Design of Mixers at GHz frequency range, various mixers- working and implementation, Power Amplifier design.

Module 5:RF Circuits Design

Basic topologies VCO and definition of phase noise, Noise power and trade off. Resonator VCO designs, Quadrature and single sideband generators.

Module **6: Oscillators**

PLLS, Various RF synthesizer architectures and frequency dividers.

Module 7: Radio frequency Synthesizers

Recommended Reading

1. Thomas H. Lee "Design of CMOS RF Integrated Circuits" Cambridge University press 1998.
2. B. Razavi"RF Microelectronics" PHI, 1998.
3. R. Jacob Baker, H.W. Li, D.E. Boyce "CMOS Circiut Design, layout and Simulation" PHI,1998.
4. Y.P. Tsividis"Mixed Analog and Digital Devices and Technology", TMH 1996

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-I
Course Code	**EC5106T**
Course Title	**RF INTEGRATED CIRCUITS LAB**

COURSE OBJECTIVE

- To design and simulate Analog and Digital modulation for RF circuits.
- To get acquainted with BJT & MOSFET behavior at RF frequencies.
- Modeling of transistor & SPICE model.
- To design Low noise amplifier, Mixer, Oscillator, VCO, synthesizer & Power amplifier.

COURSE OUTCOME

- To differentiate the response of BJT and MOSFET at low frequency and RF frequency using modeling.
- To get familiarized with various RF devices, PLLs, Various RF synthesizer architectures and frequency dividers.

Overview

Experiment based on design and simulation of the following:

1. Analog and Digital modulation for RF circuits.
2. BJT & MOSFET behavior at RF analog and digital modulation for RF frequencies.
3. Modeling of transistor & SPICE model.
4. Low noise amplifier design.
5. Mixer design at Gigahertz frequencies.
6. Oscillator design.
7. VCO design.
8. RF synthesizer and frequency divider.
9. Power amplifier design.

Recommended Reading

1. Thomas H. Lee “Design of CMOS RF Integrated Circuits” Cambridge University press 1998.
2. B. Razavi“RF Microelectronics” PHI, 1998.
3. R. Jacob Baker, H.W. Li, D.E. Boyce “CMOS Circiut Design, layout and Simulation” PHI,1998.
4. Y.P. Tsividis“Mixed Analog and Digital Devices and Technology”, TMH 1996

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II
Course Code	**EC5006S**
Course Title	**ADVANCED DIGITAL SIGNAL PROCESSING**

COURSE OBJECTIVE

- To introduce the basic concepts of multirate signal processing, random process and wavelets

COURSE OUTCOME

- Students should be able to analyze signal by splitting into different levels to obtain better frequency resolution. Also reconstruction with the required information for specific applications.
- Students should be able to model the random processes.
- Students should be able apply wavelet analysis to signal and image processing applications.

Overview

Module 1: Multirate Digital Signal Processing

Sampling, Comparison of analog and digital spectrum with different sampling frequency, aliasing, Decimation, Interpolation, multi stage interpolators and decimators, Filter design and implementation, Application of multirate signal processing.

Module 2: Spectral Estimation for Discrete Time random processes

Definitions and representation of random process, parametric and non parametric spectral estimations; estimation of auto correlation and power density spectrum. Filtering random process. Non parametric techniques like: periodogram, modified periodogramBarlett, Welch & Blackman-Tuckey, approach Parametric Techniques: Yule Walker Method and Power spectrum method for modeling: Autoregressive (AR), Moving Average (MA) and Autoregressive Moving average (ARMA)

Module 3: Wavelets

Review Fourier transform, Short-time Fourier transform, Introduce time frequency resolution, orthogonality and orthonormality, Continuous time wavelet transform, Discrete wavelet transform Analysis using Harr scaling and wavelet functions, refinement relations, Analysis and synthesis refinement equations Tiling of the time-frequency plane and wavepacket analysis

Recommended Reading

1. S.M. Kay, Modern Spectral Estimation, Prentice hall, 1988.
2. J. G. Proakies, D.G. Manolakis, and D. Sharma, "*Digital Time Signal Processing: principles,algorithms, and applications,"* Pearson Education, 2006.
3. DaFatta, D. J., Lucas, J. G., and Hodgkiss, W. S. "*Digital Signal Processing: A system design approach*," Wiley publications, 1988.
4. R. M. Rao, and A.S. Bopardikar, "*Wavelet Transforms,"* Pearson Education, 2001.
5. C. S. Burrus, R. A. Gopinath, and H. Guo,."*Introduction to Wavelets and Wavelets Transforms*,"PrenticeHall, 1998.
6. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, 1993.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II**
Course Code	**EC5007T**
Course Title	**NANO ELECTRONICS**

COURSE OBJECTIVE

- To study limitations of scaling of CMOS technology and its remedies.
- To study transition from single gate to multigate technology.
- To study different nanoscale devices like RTD, QCA, CNT, nanowire, SET.
- To introduce spin phenomena and its applications for nanoscale devices.
- To study molecular electronic devices.

COURSE OUTCOME

- The student should be familiar with certain nanoelectronic systems and building blocks such as: low-dimensional semiconductors, heterostructures, carbon nanotubes, quantum dots, nanowires etc.
- Design of electronic nanosystems like memory elements & Logic devices.
- Finally, a goal is to familiarize students with the present research front in Nanoelectronics and to be able to critically assess future trends.

Overview

Module 1: Introduction

CMOS Scaling, Scaling Issues, Limit to Scaling, System Integration limit, Interconnect Issues, Shrinkdown approach, Strained Silicon, High k dielectric, Advance MOSFET concept, UTB – Ultra Thin Body, and Metal Gate.

Module 2: FINFET

Structure, working, power optimization, logic design using FINFET, modes of operation, TCMS circuit, logic design using TCMS, FINFET SRAM Design

Module 3. Resonant Tunneling Diode (RTD)

Electron Tunneling, Coulomb blocked RTD Structure, working, V-I characteristics, equivalent circuit ,programmable logic gates,multi valued logicgates and MOBILE circuit.

Module 4. Single Electron Devices

Single Electron BOX, Single Electron Transistor (SET), and Application of Single Electron Devices for logic circuit.

Module 5. Quantum dots

Electronics properties, structure, Quantum Cellular Automata (QCA) , and Circuit Design using QCA.

Module 6. Carbon Nanotube

Physical Properties, Band Structure, Band Modulation, Electrical properties of CNTs, CNT Transistor, CNT based Electronics Devices, Field Emission Devices, MEMS, Electrical Sensor, and SRAM Cells.

Module 7. Spintronics

Physical properties of Spintronic Devices, Spin Relaxation Mechanisms, Spin Injection, Spin Detection. Spintronic Devices, Spin Filter, Spin Valves, Spin Pumps, Spin Diodes, Spin Transistors, Spin-Based Optoelectronic Devices, Spintronic Computation.

Module 8. Molecular Electronics Devices

Electrical Conduction of Molecules, Molecular Electronics Devices, Molecular Architectures for Nanoelectronics, Molecular-Based Optic and Optoelectronics Devices, Molecular Computing Devices.

Recommended Reading

1. Introduction to nanotechnology, C.P.Poole JV, F.J.Owens, Wiley (2003).
2. Nanoelectronics and information technology (Advanced electronic materials and Novel Devices Waster Ranior, Wiley VCH (2003)
3. Nanoelectronics: Principles and Devices, 2nd Edition, M. Dragoman, D. Dragoman, Artech House - 2008
4. Nanoelectronic Circuit Design, Niraj K. Jha, Deming Chen, Springer - 2010.

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II
Course Code	**EC5007P**
Course Title	**NANO ELECTRONICS LAB**

COURSE OBJECTIVE

- To perform experiments of semiconductor devices using different tools on Nanohub.org.

COURSE OUTCOME

- Students should be able to perform experiment based on design and simulation of different semiconductor devices.
- Students should observe effects of temperature, doping, device scaling, materials on current-voltage characteristics and capacitance, etc.

Overview

Experiment based on design and simulation of the following:

1. Effect of doping on semiconductor
2. Different crystal structure
3. MOSFET Characteristics
4. MOSFET capacitance
5. FINFET ,double gate and multigate FET characteristics
6. Characteristics of Resonant tunelling diode
7. Characteristics of CNTFET
8. CNT based NEMS with cantilever structure
9. Characteristics of Nanowire FET
10. Band structure and corresponding density of states of CNT
11. 3D wave function and various characteristics of an electron confined dot

Recommended Reading

1. Rainer Waser , Nanotechnology, volume 3:Information Technology I
2. Niraj K. Jha, Deming Chen, Nanoelectronic Circuit Design, Springer)

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II**
Course Code	**EC5008T**
Course Title	**EMBEDDED SYSTEM DESIGN**

COURSE OBJECTIVE

- To implement research oriented concepts in embedded system.
- Complete design of an embedded system with functional requirements for hardware and software components including processor, networking components, along with applications, subsystem interfaces, networking, and middleware.
- Understand interprocess communication and the role of middleware.
- Understand network protocol layers and explain the specific role of each.
- Develop standard project plans for a software development team including interface definition.
- To study different operating systems including Mobile, Embedded and RTOS.

COURSE OUTCOME

- Students should be able to design embedded systems.
- Students should understand the general process of embedded system development
- Ability to use C to develop embedded software.
- Students should be able to interface peripherals, knowledge of typical interfacing standards.
- Understanding of what an embedded system R&D project is, and the activities it involves.

Overview

Module 1. Introduction

Features of embedded system, general architecture, classification, skills required, parameters and metrics, trade offs, hardware and software components.

Module 2.Embedded Hardware

Embedded processor requirements, features, types, organization, selection of processors, microcontrollers, selection of microcontrollers, instruction set architecture, RISC processors, Harvard architecture, super Harvard architecture, target boards, memory requirements, memory organization, parameters, types, selection of memory, trade offs, IO requirements, IO devices like display, keyboards, ADC, DAC, UART, modem, timer, pulse dialer, mechatronic devices, printers etc.

Module 3. Embedded software

Structure, comparison with desktop software, requirements, parameters, software developments tools, cross platform development, programming languages like embedded C, embedded C++ and JAVA, device drivers, debuggers, profilers, code optimization, Real time O.S., features, architectures, kernels objects, semaphore, mutex, shared data problems, schedulers, reentrancy, queues, mail boxes, pipes, timers, event management, intertask communication, memory managements, embedded OS. Linux, RTLinux, Palm OS, Mobile OS like Symbionetc, multiprocessor software developments, data flow graph, FSM model, petri net model, multithreading. Study and programming of RTOS like RTX5 1, VxWorks, Andriod etc.

Module 4. Embedded communication

Mobile devices communication interfaces like RS232, RS422, USB, IrDA, Ethernet, IEEE 802.11, Blue tooth, development environment, J2ME, RFID system, DSP architecture, DSP based embedded system, embedded communication systems like smart phones, smart card, mobile, lap, global positioning system, set top boxes etc.

Module 5. Embedded system design methodology

System development process, Requirements engineering, reverse engineering, design tradeoffs, co design, SOC, implementation, Integration, testing like testing on the host system, testing on target board, environmental testing, packaging, configuration management, embedded project management, embedded system fiascos.

Module 6. Embedded processors

Embedded processor models, Application specific processor like network processors, multimedia processors, industrial processors etc. Digital signal processors, superscalar processor, Advanced RISC processors, and ARM processors, DsPIC Microcontroller

Recommended Reading

1. Raj Kamal “Embedded system” Tata McGraw Hill
2. Prasad “Embedded Real time systems” Dream tech Wiley Publication.
3. David Simon, “An embedded Software Primer” Pearson Publication
4. Frank Vahid, “Embedded system — A unified Hardware Software Introduction” John Wiley and Sons.
5. Embedded System Architecture By Tammy Noergaard Elsevier publication

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II**
Course Code	**EC5008T**
Course Title	**EMBEDDED SYSTEM DESIGN LAB**

COURSE OBJECTIVE

- Study of different Embedded Software Development Tools like Keil µvision, Proteus, Flowcode.
- To perform experiments on the Embedded Hardware Development Board.
- To perform experiments on RTX51Tiny and study its features.
- To Verify Communication Protocol like RS232,I2C, SPI, CAN, Ethernet Wired buses and Bluetooth, IrDA and Zigbee and Wifi buses.

COURSE OUTCOME

- Students should be able to do Embedded C programming.
- Students should be able to perform experiments on different development boards.
- Students should get introduced with application of embedded system in different fields.

Overview

1) Embedded Software Development Tools:-Keil µ vision 3 and 4 project management, Study How to create Embedded Project, Compile and Test Project for 8051 and it's Derivative, Testing of 8051 based project on Target Board, Programming of Flash Memory, Project on MPLAB, How to use Debugger. Flowcode.

2) Embedded Hardware Development Board:-To Study 8051 and PIC Board Architecture, Study Communication Interface of Board like RS232,USB, and JTAG.

3) Embedded C programming: - Programming of 8051, PIC , AVR and ARM in C

4) Embedded Testing:-Logic Analyzer for Embedded Testing.

5) RTOS:-Study of Various Commands of RTOS like RTX51 tiny. Free RTOS, RTLinux and programming

6) Embedded Communication System design :- Verification of Communication Protocol like RS232,I2C, SPI, CAN, Ethernet Wired buses and Bluetooth, IrDA and Zigbee and Wifi buses.

7) Real Time Programming in C, J2ME in JAVA, Symbion Programming ,Andriod
Embedded system development on EDK(Xilinx) and PSOC

Recommended Reading

1. Raj Kamal “Embedded system” Tata McGraw Hill
2. Prasad “Embedded Real time systems” Dream tech Wiley Publication.
3. David Simon, “An embedded Software Primer” Pearson Publication
4. Frank Vahid, “Embedded system — A unified Hardware Software Introduction” John Wiley and Sons.
5. Embedded System Architecture By Tammy Noergaard Elsevier publication

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II**
Course Code	**EC5111S**
Course Title	**SPEECH PROCESSING**

COURSE OBJECTIVE

- To introduce the characteristics of Speech signals and the related time and frequency domain representations.
- To introduce the different applications of speech like synthesis , coding and recognition

COURSE OUTCOME

- Students should be able analyze the speech signal and to identify the different parameters of speech signal like voiced/unvoiced, vowel/consonant, types of articulation etc.
- Students should have a basic understanding about the different applications of speech processing.

Overview

Module 1: Speech production and perception

Speech production mechanism, Auditory System and Hearing Mechanism, Classification of speech, sounds, nature of speech signal, models of speech production. Speech signal processing: purpose of speech processing, digital models for speech signal, Digital processing of speech signals, Significance, short time analysis.

Module 2: Time domain methods for speech processing

Time domain parameters of speech, methods for extracting the parameters, Zero crossings, Auto correlation function, pitch estimation.

Module 3. Frequency domain methods for speech processing

Short time Fourier analysis, filter bank analysis, spectrographic analysis, Format extraction, pitch extraction, Analysis - synthesis systems, Auditory models

Module 4: Linear predictive coding of speech

Formulation of linear prediction problem in time domain, solution of normal equations, Interpretation of linear prediction in auto correlation and spectral domains.

Module 5: Speech signal analysis

Cepstral analysis of speech, Mel frequency cepstral coefficients (MFCC), format and pitch estimation

Module 6. Application of speech processing

Speech Synthesis, Speech Coding, Speech and Speaker recognition and verification. Vector quantization, Hidden Markov modeling for isolated word and continuous speech recognition.

Recommended Reading

1. Lawrence Rabiner and Ronals Schafer, "Theory and Applications of Digital Speech Processing", Prentice Hall, 2011
2. T.F. Quatieri, Discrete-Time Speech Signal Processing, Prentice Hall 2002.
3. L.T. Rabiner and R. Schafer, Digital Processing of Speech Signals, Prentice Hall, 1978.
4. Douglas O"Shaughnessy, Speech Communciations: Human and Machine, Universities Press, 2001.
5. J.L Flanagan : Speech Analysis Synthesis and Perception - SprengerVertag,
6. I.H.Witten :Principles of Computer Speech , Academic press.

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II
Course Code	EC5112S
Course Title	NANO LOGIC DESIGN

COURSE OBJECTIVE

- To get prepared for nano IC design and quantum computing
- Exploiting non-classical CMOS devices for circuit design in such technologies
- Knowledge of prospects of future non-silicon nanotechnologies

COURSE OUTCOME

- Design of electronic nanosystems like memory elements & Logic devices.
- Design of multilevel nanologic devices using N-hypercube, graph based models.
- Finally, the goal is to familiarize students with the present research front in Nanoelectronics and to be able to critically assess future trends.

Overview

Module 1: Introduction

Basics of nanoelectronics, Computational paradigms for nano computing structures, biological inspiration for computing, molecular computing devices, logic design in special dimensions, CAD of nano ICs. Methodologies, data structures.

Module 2: Nano technologies

Nano electronics devices, digital nanoscale circuits, single electron memory, switches in single electron logic, interconnection problem in voltage state devices, neuron cell and cellular network design using SETs, single electron systolic array, CMOS molecular electronics, scaling and operational limits of nanoelectronics devices, carbon nano tube based logic devices, quantum devices.

Module 3: Basics logic design in nano space

Graphs, trees, Reed Mullar expansions, Decision trees and diagrams, Arithmetic expressions, Voronoi diagrams, Boolean vectors, local transformation, monotonic Boolean functions, linear Boolean functions, Cubical representation of Boolean functions, threshold logic, Symmetric function computing, Boolean Taylor expansion, Boolean matrices, algebra of polynomial form, GF(2) algebra, factorization of polynomial, Davio expansions

Module 4: Word-Level logic design

Word-level data structures, Word-level arithmetic expressions, Word-level sum-of-products expressions, Word-level Reed-Muller expressions

Module 5: Nano space data structure

Spatial structures,Hypercube data structure, Assembling of hypercubes, N-hypercube definition,Degree of freedom and rotation, Coordinate description, N-hypercube design for n > 3 dimensions, Embedding a binary decision tree in N-hypercube, Assembling, Spatial topological measurements

Module 6. Multilevel nano logic design

Graph-based models in logic design of multilevel networks, Library of N-hypercubes for elementary logic functions, Hybrid design paradigm: N-hypercube and DAG, Manipulation of N-hypercubes, Numerical evaluation of 3-D structures,Linear expressions, Linear arithmetic expressions, Linear arithmetic expressions of elementary functions, Linear decision diagrams, Technique for manipulating the coefficients, Linear word-level sum-of-products expressions, Linear word-level Reed-Muller expressions

Module 7: Multivalued nano logic design

Introduction to multivalued logic, Spectral technique, Multivalued decision trees and decision diagrams, Concept of change in multivalued circuits, Generation of Reed-Muller expressions, Linear word-level expressions of multivalued functions, Linear nonarithmetic word-level representation of multivalued functions

Recommended Reading

1. “Logic synthesis and verification algorithm” Gary Hachtel, Kluwer academic publication
2. “ Logic design of nano ICs” Svetlana Yanushkevich, CRC press
3. “Multiple valued logic- concepts and representation” De Michael Miller, Morgan and clay pool publication
4. “ Synthesis and optimization of digital circuits” Giovanni De Micheli, McGraw Hill
5. “Computer Arithmetic for Nanoelectronics by Vlad P Shmerko CRC press
6. “Decision Diagram techniques for Micro and Nano electronic Design Handbook” Svetlana N Yanushkevich BPB publications

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II
Course Code	EC5113S
Course Title	COMPUTER ARCHITECTURE

COURSE OBJECTIVES

1. To develop an understanding of enhancements in building block of computer systems
2. To acquaint students with processor and memory structures as well as I/O techniques
3. To understand parallel processing concepts

COURSE OUTCOMES

At the end of the course, the student will be able to:

1. Analyze various architectural enhancements like pipelining, branch prediction logic and superscalar architectures that contribute to improved performance in modern processors.
2. Analyze and implement the memory architectures in computing systems which include cache memories, main memories as well as secondary storage.
3. Design interfacing of Input and Output devices as well as standard I/O buses such as PCI and USB.
4. Explain concepts related to parallel processing such as Instruction-level parallelism, Symmetric Multiprocessors, Cache coherence, Multithreading and Chip Multiprocessors, Clusters, Non-uniform Memory Access Computers, Vector Computation.

Overview

Module 1: Introduction

A Top Level View of Computer functions and Interconnections, Computer Components, ComputerFunctions, Interconnection Structures,Bus Interconnections, Performance metrics.

Module 2: Processor Structure and Functions

Basic CPU organization, stages of execution, single-cycle and multiple-cycle designs, microprogramming vs. hardwired control, interrupts, CISC and RISC Architectures , Concept of Pipelining, Hazards, Superscalar processors, Branch prediction logic . A Case Study on the Pentium.

Module 3: Memory

Semiconductor Memories / DRAM organization, Cache Memory : Principles, Cache Architectures, Cache Organization, Coherency, Cache Design, External Memories: Magnetic , Optical, RAID ,Virtual memory management .

Module 4: Input/ Output

Types of I/Os, I/O Interfacing Concepts, I/O Buses: PCI,USB

Module 5: Parallel Processing

Introduction, Amdahl's law, Instruction-level parallelism ,Symmetric Multiprocessors, Cache Coherence and the MESI Protocol, Multithreading and Chip Multiprocessors, Clusters, Non-uniform Memory Access Computers ,Vector Computation.

Recommended Reading

1. “Logic synthesis and verification algorithm” Gary Hachtel, Kluwer academic publication
2. “ Logic design of nano ICs” Svetlana Yanushkevich, CRC press
3. “Multiple valued logic- concepts and representation” De Michael Miller, Morgan and clay pool publication
4. “ Synthesis and optimization of digital circuits” Giovanni De Micheli, McGraw Hill
5. “Computer Arithmetic for Nanoelectronics by Vlad P Shmerko CRC press
6. “Decision Diagram techniques for Micro and Nano electronic Design Handbook” Svetlana N Yanushkevich BPB publications

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II**
Course Code	**EC5114T**
Course Title	**VIRTUAL INSTRUMENTATION**

COURSE OBJECTIVES

- It provides new concepts towards measurement and automation.
- It imbibes knowledge about how to control an external measuring device by interfacing a computer.
- To become competent in data acquisition and instrument control.
- To learn applications of programming, data acquisition, data analysis, and signal processing used in the design of medical and Laboratory instrumentation.
- To learn LABVIEW as a tool for the design of computer-based virtual instruments, with added software-based intelligence to sensors and basic Laboratory bench devices.
- To learn basic concepts of LABVIEW programming like Structures, Arrays and Clusters , Charts and Graphs, File input and outputs etc.

COURSE OUTCOME

At the end of the course, the student will be able to

- Acquire knowledge on how virtual instrumentation can be applied for data acquisition and instrument control.
- Identify salient traits of a virtual instrument and incorporate these traits in their projects.
- Experiment, analyze and document in the Laboratory prototype measurement systems using a computer, plug-in DAQ interfaces and bench level instruments.
- Design instrumentation systems involving signal sensing and conditioning, data acquisition, data analysis, signal processing, and human computer interface.
- Students will get idea of application of VI in embedded systems, image processing, medical field, control system and instrumentation engineering etc.

Overview

Module 1: Introduction to Virtual Instrumentation-LABVIEW

LABVIEW environment-Pop-Up Menus, Palettes-Tools, Controls and Functions Palette. Editing and debugging tools.

Module 2: Sub VI and Express VI

Sub VI-Definition and utility, creating sub VI-connector and selection method. Express VI-utility, generation of signal using express VI.

Module 3. Structures

Formula node, MATLAB script node, Loops- FOR and WHILE loops, use of shift registers, case, event, global VI and flat sequence structure.

Module 4: Arrays and Clusters

Arrays, concept of Auto-indexing, creating array controls and indicators, array operations. Clusters, creating clusters controls and indicators, cluster operations. Inter-conversion of arrays and clusters.

Module 5: Charts and Graphs

Charts, scope, strip and sweep charts. Graphs, waveform graphs and XY graphs

Module 6. Signal generation, processing and analysis using LABVIEW

Wave and pattern VI, finding FFT using different windows, signal processing and analysis operations.

Module 7: File input and outputs

File formats, file I/O functions, path functions, writing to and reading from files and spreadsheet.

Module 8: Data acquisition

Measurement and Automation Explorer (MAX),Acquiring and measuring data, DAQ in LABVIEW, DAQ assistant, task timing and task triggering in DAQ assistant, NI-DAQmax task, it's configuration, testing and measurements. Instrument control using LABVIEW

Module 9. Applications of Virtual Instruments

Recommended Reading

1. www.ni.com
2. Virtual Instrumentati0on using LABVIEW-Sanjay Gupta and Joseph John, TMH Publications, 2013.
3. LABVIEW for Everyone: Graphical Programming Made Easy and Fun by Jeffrey Travis , Jim Kring, Prentice Hall Publications,2006.
4. Learning with LABVIEW 2009,by Robert H. BishopPrentice Hall Publication,1st edition ,2009

5. LABVIEW Applications and Solutions by Rahman Jamal, Herbert Pichlik ,Prentice Hall Publications,1999.
6. LABVIEW Signal Processing by Mahesh L. Chugani,Abhay.R.Samant, Michael Cerna, Prentice Hall Publications,1998.
7. Basic Concepts of LABVIEW,by Leonard Sokoloff ,Prentice Hall publications,1997.

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II
Course Code	EC5114P
Course Title	VIRTUAL INSTRUMENTATION LAB

COURSE OBJECTIVES

- To understand basics of LABVIEW software.
- To perform experiments using all functions of LABVIEW.
- To study applications of LABVIEW using data acquisition.

COURSE OUTCOME

At the end of the course, the student will be able to

- Have understanding of LABVIEW software.
- Have hands on training using LABVIEW.
- Have knowledge of LABVIEW applications using data acquisition

Overview

- Introduction to LABVIEW software, study of palettes. To perform experiments using basic functions of LABVIEW like arithmetic, logical, comparison etc.
- Familiarization with creating a VI, converting a VI into Sub VI, debugging tools, loops, shift registers, local variable etc.
- To perform file I/O operations, various types of files.
- Use of arrays, clusters, polymorphism, auto indexing etc., various structures like formula node, case structure, global variable, graph tools like charts and graphs.
- To get familiar with various data acquisition options using LABVIEW. Study of NI ELVIS and its various operations. Data acquisition using NI ELVIS.
- To develop basic applications in the LABVIEW environment.

Recommended Reading

1. www.ni.com
2. Virtual Instrumentati0on using LABVIEW-Sanjay Gupta and Joseph John, TMH Publications, 2013.
3. LABVIEW for Everyone: Graphical Programming Made Easy and Fun by Jeffrey Travis , Jim Kring, Prentice Hall Publications,2006.
4. Learning with LABVIEW 2009,by Robert H. BishopPrentice Hall Publication,1st edition ,2009
5. LABVIEW Applications and Solutions by Rahman Jamal, Herbert Pichlik ,Prentice Hall Publications,1999.

Programme Name	**M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II**
Course Code	**EC5115T**
Course Title	**ADVANCED MOBILE COMMUNICATION**

COURSE OBJECTIVE

- To provide the student with an understanding of the Cellular concept, Frequency reuse, Hand-off strategies.
- To enable the student to analyze and design wireless and mobile cellular communication systems over a fading channel
- To provide the student with an understanding of Equalization and diversity reception techniques
- To give the student an understanding of digital cellular systems (GSM, CDMA)
- To give the student an understanding of present day cellular technologies implemented in LTE like OFDM, MIMO systems

COURSE OUTCOME

- By the end of the course, the student will be able to analyze and design wireless and mobile cellular systems.
- The student will be able to understand impairments due to multipath fading channel and be able simulate standard stochastic channel models for various environments.
- The student will be able understand the fundamental techniques to overcome the different fading effects.
- The student will have detailed understanding of current and proposed cellular technologies.
- The student will have the ability to work in advanced research wireless and mobile cellular technologies.

Overview

MODULE 1: Review of MOBILE RADIO STANDARDS AND CELLULAR CONCEPT

Evolution of Mobile radio communications – Mobile radio systems in the U.S. and around the world –Examples of Mobile radio systems.Cellular concept – Frequency reuse – Channel Assignment strategies – Handoff strategies – Interferenceand System capacity – Trunking and Grade of service – Improving capacity in cellular systems.

MODULE 2: Mobile radio propagation

Small-scale multipath propagation – Impulse response of a multipath channel – Parameters of mobilemultipath channel – Types of small-scale fading – Rayleigh and Rician distributions – Statistical modelsfor multipath fading channels.

MODULE 3: Mobile system and network architectures

GSM services and features – GSM system architecture – GSM radio subsystem – Frame structure for GSM– Signal processing in GSM – GPRS network architecture – GPRS services, IS-95 The North American CDMA

MODULE 4: Third generation mobile communication system

Need of 3G Cellular N/w, IMT 2000 Global Standard, W-CDMA Air interface, TD-SCDMA Technology,CDMA 2000 Cellular Technology

MODULE 5: 4G Mobile communication

4G introduction and standards :IEEE 802.16, WiMAX Forum, 3GPP and IMT-Advanced; Overview of WiMAX and LTE standards and network architectures

Recommended Reading

1. T.S. Rappaport, “Wireless Communication, principles & practice”, Prentice Hall of India
2. William Stallings, “Wireless Communication and Networking”, Pearson Education, 2002.
3. Raj Pandya, “Mobile and Personal Communication Systems and Services”, PHI, 2001.
4. ItiSahaMisra, “ Wireless Communications and Network”, McGraw Hill Education Pvt. Ltd.2009

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II
Course Code	EC5115P
Course Title	ADVANCED MOBILE COMMUNICATION LAB

COURSE OBJECTIVE

- Study the basic path loss models and their effects of modern day communication links and practical link budget limitations.
- During these sessions actual practice and realization of the concepts studied would be emphasized.

COURSE OUTCOME

- Students will be able to make performance decisions on practical link establishment, problems and suggested solutions.
- Students will also be Performance measurements for link establishment.

Overview

I. Wireless Path loss - Study of Propagation Path loss Models: Indoor & Outdoor

1. Free Space Propagation – Path Loss Model
2. Multipath Fading in Cellular Mobile Communication
3. Link Budget Equation for Satellite Communication
4. Carrier to Noise Ratio in Satellite Communication
5. Outdoor Propagation – Okumura Model
6. Outdoor Propagation – Hata Model

II. Study of GSM Technology using mat LAB simulation and modules

1. Study of the Tx IQ/Rx IQ signals.
2. Performance of SIM Detection
3. GSM Data services & capability
4. Radio Resource Allocations and Scheduling in Cellular Mobile Communication

III. Study of CDMA Technology

1. Generation of Direct sequence spread spectrum (DS-SS)
2. Reception of Direct sequence spread spectrum (DS-SS)
3. Generation of frequency hoped spread spectrum (FH-SS)
4. Reception of frequency hoped spread spectrum (FH-SS)
5. Generation of Hadamard Codes

IV. Study and Implementation of RAKE Receiver

V. Design and Implementation of Equaliser.

Recommended Reading

1. T.S. Rappaport, “Wireless Communication, principles & practice”, Prentice Hall of India
2. William Stallings, “Wireless Communication and Networking”, Pearson Education, 2002.
3. Raj Pandya, “Mobile and Personal Communication Systems and Services”, PHI, 2001.
4. ItiSahaMisra, “ Wireless Communications and Network”, McGraw Hill Education Pvt. Ltd.2009.
5. GSM Manual
6. CDMA Manual

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II
Course Code	EC5116T
Course Title	ADVANCED IMAGE AND VIDEO PROCESSING

COURSE OBJECTIVE

- The objectives of this course are for students to learn the fundamental theories and techniques of digital image and video processing.
- To study image representation and different transforms.
- To study pre-processing of images and modeling of images.
- To understand different features of image and extraction of these features from image.
- To understand the basics of video object extractions.

COURSE OUTCOME

- Understanding of digital image processing fundamentals: hardware and software, digitization, enhancement and restoration, encoding, segmentation, feature detection.
- Ability to apply image processing techniques in both the spatial and frequency (Fourier) domains.
- Ability to apply video processing techniques to extract the objects.

Overview

Module 1: Image representation and transforms

Image Representation- Image Basis Functions- Two dimensional DFT- Discrete cosine Transform-Walsh-Hadamard transform-Wavelet transform - Construction of Wavelets-Types of wavelets principal component analysis.

Module 2: Pre-processing and modeling of images

Pre-processing of images- Histogram equalization - edge detection- Stochastic presentation of images- Stationary and Non-stationary models - Gaussian- HMM - Edge and texture models.

Module 3: Spatial feature extraction

Filtering techniques- Localized feature extraction- Boundary Descriptors-Moments- Texture

Descriptors- Co-occurrence features- Run length features- Feature selection.

Module 4: Classifiers

Maximum Likelihood Estimation- Bayesian approach- Pattern Classification by distance functions-BPN.

Module 5: Video object extraction

Static and dynamic background modelling - frame subtraction- optical flow techniques- Handling occlusion- scale and appearance changes - Shadow removal.

Recommended Reading

1. A.K.Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall, 1989.
2. A.Bovik, “Handbook of Image and Video Processing”, 2nd Edition, Academic Press, 2005.
3. Mark Nixon and Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press,2008. John C.Russ, “The Image Processing Handbook”, CRC Press, 2007.
4. Richard O. Duda, Peter E. Hart and David G. Stork., “Pattern classification”, Wiley, 2001.
5. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011.

Programme Name	M. Tech. (Electrical Engineering with specialization in Electronics), SEMESTER-II
Course Code	EC5116P
Course Title	ADVANCED IMAGE AND VIDEO PROCESSING LAB

Course Objective

- To study image representation in different domains and their analysis.
- To explore algorithm and techniques involved in image processing.
- Understand the concept of image processing in computers.

Course Outcome

- Students will come to know how the processing on image and video signals takes place before it is transmitted on the communication channel.
- Various transforms will be used for the processing of these signals.

Overview

1. Introduction to Image and Video Processing.
2. 2D and 3D signals and systems, linear and shift invariant systems (convolution)
3. 2D and 3D Fourier transform, 2D and 3D discrete-Fourier transform, uniform sampling
4. Motion estimation and its applications
5. Image and video enhancement
6. Image recovery (restoration, super-resolution)
7. Video recovery (restoration, super-resolution)
8. Lossless compression
9. Image compression techniques and standards
10. Image and video analysis (e.g., 2D and 3D segmentation, anomaly detection, clustering)

Recommended Reading

1. A.K.Jain, “Fundamentals of Digital Image Processing”, Prentice-Hall, 1989.
2. A.Bovik, “Handbook of Image and Video Processing”, 2nd Edition, Academic Press, 2005.
3. Mark Nixon and Alberto Aguado, “Feature Extraction and Image Processing”, Academic Press,2008. John C.Russ, “The Image Processing Handbook”, CRC Press, 2007.
4. Richard O. Duda, Peter E. Hart and David G. Stork., “Pattern classification”, Wiley, 2001.
5. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer, 2011.